Appendix C

Rectification

The rectification procedure discussed in Section 2.3.3 approaches the rectification problem from the perspective of camera rotations about the optical centers of the cameras. This rotation must align the optical axes (i.e., make them parallel) and mutually perpendicular to the baseline (i.e., 3D line) connecting the camera centers. By itself, this process leaves the direction of the optical axes under-constrained, free to rotate in the plane whose surface normal is given by the baseline. In order to constrain this degree of freedom, we require that the rectified optical axes have minimum deviation from the average of the two unrectified optical axes. To implement this strategy, we compute the average direction of the two input optical axes, and then remove the portion of that direction that lies along the computed baseline. This difference is orthogonal to the baseline and minimally different from the average direction. The rectification procedure is then given below. The camera centers are assumed to be specified in the world coordinates, as all vectors are 3D vectors in the world coordinate system.

Algorithm: Rectify Camera Pair

$\overline{\text{baseline}} = \overline{\text{camcenter1}} - \overline{\text{camcenter2}};$
$\overline{\text{Xaxis}} = \text{normalize}\ (\overline{\text{baseline}});$

$\overline{\text{avgZaxis}} = \text{normalize}\ (\overline{\text{Zaxis1}} + \overline{\text{Zaxis2}});$
$\text{coef} = \overline{\text{Xaxis}} \cdot \overline{\text{avgZaxis}};$
$\overline{\text{tmpaxis}} = \overline{\text{avgZaxis}} - (\text{coef} * \overline{\text{Xaxis}});$
$\overline{\text{Zaxis}} = \text{normalize}\ (\overline{\text{tmpaxis}});$

$\overline{\text{tmpaxis}} = \overline{\text{Zaxis}} \times \overline{\text{Xaxis}};$
$\overline{\text{Yaxis}} = \text{normalize}\ (\overline{\text{tmpaxis}});$

$$R = \begin{bmatrix} Xaxis(1) & Xaxis(2) & Xaxis(3) \\ Yaxis(1) & Yaxis(2) & Yaxis(3) \\ Zaxis(1) & Zaxis(2) & Zaxis(3) \end{bmatrix}$$

$\overline{\text{translation1}} = -R \cdot \overline{\text{camcenter1}};$
$\overline{\text{translation2}} = -R \cdot \overline{\text{camcenter2}};$

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